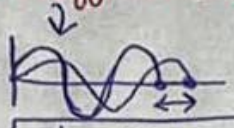
WAVE OPTICS

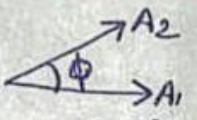
* Path difference and phase difference :-

Δx



$$\Delta\phi = \frac{2\pi}{\lambda}\Delta x$$

* Constructive and destructive interference



$y_1 = A_1 \sin \omega t$

$y_2 = A_2 \sin(\omega t + \phi)$

$A_{net}^2 = A_1^2 + A_2^2 + 2A_1A_2\cos\phi$

I (intensity) $\propto A^2$

$I_{net} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$

$\cos\phi$

$\cos\phi = 1$ (maxima)	$\cos\phi = -1$ (minima)
$\phi = 2n\pi$	$\phi = (2n-1)\pi$
$n = 0, 1, 2, 3$	$n = 1, 2, 3, 4$
$\phi = 0, 2\pi, 4\pi, 6\pi$	$\phi = \pi, 3\pi, 5\pi$
$\Delta x = \frac{2n\pi}{2\pi}\lambda$	$\Delta x = (2n-1)\frac{\pi}{\pi}$
$\Delta x = n\lambda$	$\Delta x = (2n-1)\frac{\lambda}{2}$
$\Delta x = 0, \lambda, 2\lambda$	$\Delta x = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}$

maxima;

$I_{net} = (\sqrt{I_1} + \sqrt{I_2})^2$

if $I_1 = I_2 = I_0$ $\quad I_{max} = 4I_0$

minima; $\cos\phi = 1$

$I_{net} = (\sqrt{I_1} - \sqrt{I_2})^2$

$I_{min} = 0$

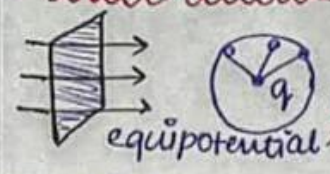
if $I_1 = I_2 = I_0$

* Width Ratio :

$$\frac{I_1}{I_2} = \frac{W_1}{W_2} = \frac{a_1^2}{a_2^2}$$

a = amplitude
W = width
I = intensity

* Huygen's principle :



wave front = same phase wave

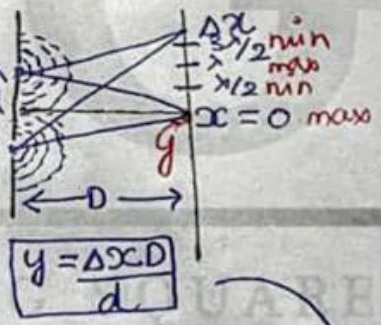


⊗ Young's double slit experiment

maxima & minima obtain on screen

Coherent = wave produced with same frequency and a constant phase difference.

Incoherent = wave produced with different frequency and $\Delta\phi$ is not constant w.r.t time.

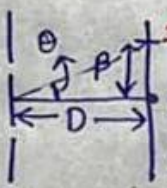


$$y = \frac{\Delta x D}{d}$$

Fringe width :

$\Delta x = \lambda$

$\frac{\lambda D}{d}$ 1st max



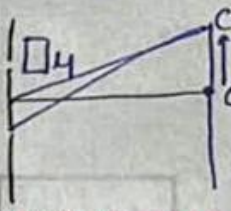
$\{\tan\theta_B = \frac{\beta}{D}\}$

$\theta_B = \frac{\beta}{D}$ $\quad \beta = \frac{\lambda D}{d}$

Angular fringe width :

$\{\frac{\beta}{D} = \frac{\lambda}{d}\}$

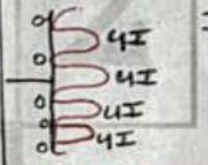
If a transparent medium of refractive index μ and thickness t is introduced in one of the paths of interfering waves.



$\Delta x = (\mu - 1)t$

$$y = \frac{(\mu-1)tD}{d}$$

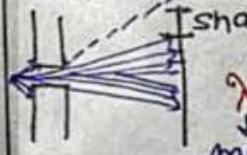
NO change in fringe width.



Intensity

* Diffraction :

encroachment of light into shadow regions



$\lambda \approx d$

meter meter

In fraunhofer diffraction

minima $\Rightarrow$ $a\sin\theta = n\lambda$

maxima $\Rightarrow a\sin\theta = (2n+1)\frac{\lambda}{2}$

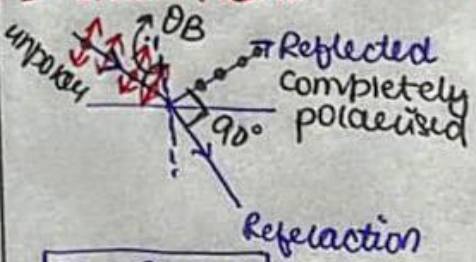
width of central maxima

$$y_{CM} = \frac{2\lambda D}{A}$$

Angular width $= \frac{2\lambda}{A}$

Polarisation :

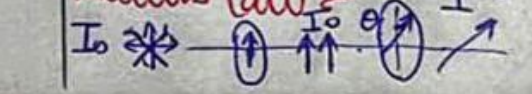
Brewster law :-



$\tan\theta_B = \mu$

θ_B = Brewster angle

Malus law :-



2.

